

Fig. 2. Comparison of acoustic pressure in the simulation (solid) and a formulation (dashed) which regards surface shear-stress fluctuations as a valid source of sound.

region near the origin. The sound field is of dipole character. The second figure shows that the computed amplitude of the sound field (solid line) agrees with a formulation (dashed line) that regards shear-stress fluctuations as acoustically compact and as a genuine source of sound. The argument presented above, against shear-stress fluctuations being a valid source, fails because even at the acoustic wavelength, the flow itself evidently makes a larger contribution to the shear-stress spectrum.

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Aeronautics Design/Test Environment Phased Microphone Array Technology

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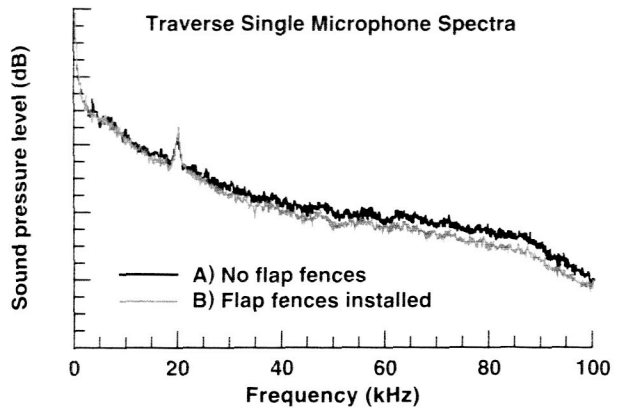
Noise has become a major driver in the design of aircraft. The development of low-noise aircraft within a rapid design-cycle process requires that the noise design be done concurrently with other disciplines such as high-lift aerodynamics and landing gear development. Phased Microphone Array Technology (PMAT), currently being developed as part of the Aeronautics Design/Test Environment effort to expand the role of the wind tunnel in the overall aircraft development process, shows great promise for attacking the noise design problem, as well as for being an instrumentation system that can be run concurrently with aerodynamic, performance, controls, and structural loads testing. Because it is nonintrusive, PMAT is compatible with optical measurement technologies that are being developed. Implementation of the array measurement capability will allow designers to evaluate the acoustic effect of design details in parallel with the aerodynamic development. This will result in a significant improvement in the present design-cycle process.

In classic acoustic testing, the result is generally a spectral plot from a single microphone. Although this

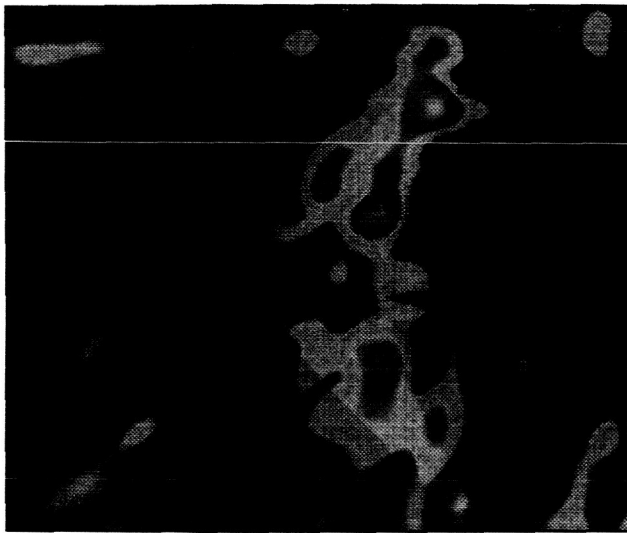
is informative, it can be ambiguous, for the spectrum contains noise from the environment as well as the noise generated by the test object. PMAT allows researchers to reduce the effect of the background noise and to locate noise sources coming only from the item being tested. This level of detail from the array results shows true effects of parameter changes, while it also reduces the corruption of the signal from the background noise. The figure shows the reduced noise as seen in the spectral plots, but also allows the researcher to see the localized effects of installing the flap fences. This detailed information could not have been acquired without PMAT.

PMAT integrates several instrumentation, computer, and high-speed network systems to produce noise maps at specified frequencies. Sources of noise on aircraft and engine models are identified and isolated through computational analysis of the signals received from the microphone array. The signals are measured with a 100-element microphone array mounted in the wind tunnel and processed on a supercomputer. The current system has the capability of returning results for 200 frequencies within about

- Demonstrates the ability to localize noise sources (flap and slat edges).
- Shows relative amplitude of localized noise sources.
- Results obtained during runs provide immediate feedback to researcher.
- PMAT complements single microphone measurements.
- Flap edge treatments show promise in meeting AST airframe noise reduction goals.



A) PMAT noise map without flap fence



B) PMAT noise map with flap fence

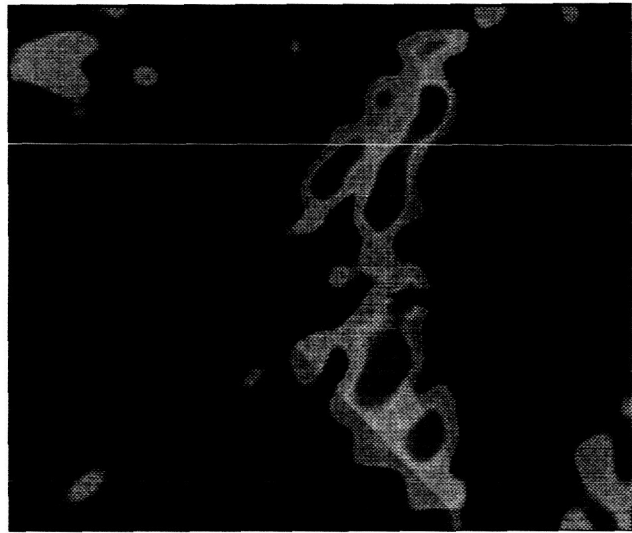


Fig. 1. PMAT array processing results.

8 minutes during a wind tunnel run. Results of the processing are displayed using a simplified, user-friendly interface to the Flow Analysis Software Toolkit software previously developed at Ames Research Center, as well as an interface developed by the PMAT team. The processing of each test point is performed before the next test condition is established. This quick turnaround of data allows researchers to guide the testing to make the best use of the test time available.

In 1997, system software for the current system, running on an HPVX1, was developed and checked

out, hardware was acquired and assembled, and the system was successfully tested in an anechoic environment in preparation for the first test in the Ames 7- by 10-Foot Wind Tunnel in early 1998. The software was also tested on data acquired from an array during a Boeing wind tunnel test.

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